REMARKS

Claims 3, 9-15, 19-24, 27, and 33-39, 43-68 are pending in the application, of which Claims 15, 39, 49, and 54 are independent claims. All Claims stand rejected under 35 U.S.C. § 103(a). In response, certain claims are amended to clarify the claimed invention.

Regarding Rejections Under Section 103

Claims 3, 9-15, 19-24, 27, 33-39, and 43-68 stand rejected under 35 U.S.C. § 103(a) based on U.S. Patent No. 5,988,165 to Richey II, et al. in view of U.S. Patent No. 6,068,448 to Muratsubaki et al., further in view of EP 1162372 to Muratsubaki et al.

Before discussing the cited references, a brief summary of the claimed invention may be helpful. The Applicants disclose and claim a compact multi-stage compressor having a ball screw drive. As a multi-stage compressor, there are at least two piston chambers, each having a different volume. When fluid in a first piston chamber is compressed, it flows to a second piston chamber having a smaller volume, where it is further compressed. The two pistons are directly connected by a threaded connecting member and a ball-screw drive is engaged with the threaded member. A reversible motor under control of a controller rotates the ball screw nut to cause reciprocating linear translation of the connecting member and pistons. As shown in FIG. 1, the piston chambers and connecting passageways are fabricated in a common housing.

In a particular embodiment, as shown in FIG. 1, the compressor is disposed between an oxygen concentrator and a portable oxygen storage tank. The use of an oxygen concentrator as an input source means that it may take time to fill the first piston chamber with oxygen. To solve that problem, the controller does not begin a piston cycle until gas with the first chamber reaches a predetermined pressure, as reported by a first pressure sensor. Thus, the number of cycles per minute will generally decrease as oxygen in the storage tank is depleted. In addition, the rotational speed of the motor can vary during a piston cycle, such as by ramping up at the beginning of a stroke and then ramping down at the end of the stroke.

Richey discusses a system for compressing oxygen-enriched gas. According to Richey, a multi-stage compressor is used to compress oxygen-enriched gas from a low-pressure buffer tank into a high-pressure storage vessel. In particular, Richey discusses a three-stage belt-driven compressor, where three pistons are actuated by a crankshaft. The compressor is driven by an

electrical motor and reduction belts are used to reduce the rotational speed of the crank shaft to approximately 50 rpm.

Richey does include a pressure sensor at the input stage from the buffer tank. If the buffer tank falls below a predetermined pressure, then the motor is turned off. Similarly, if the pressure in the storage vessel exceeds a predetermined pressure, the motor is turned off. In other words, the Richey motor either runs at about 50 rpm or it does not run at all.

Muratsubaki '448 discusses a pressure hydraulic pump used to supply a pressurized liquid for operating machinery or cutting material. The pump includes two-stages of plunger pumps driven by a ball-screw drive system. In operation, fluid is sucked into the first stage pump from a fluid reservoir. The first stage pump boosts the fluid pressure to an intermediate pressure. That fluid is sucked into the second stage pump, where its pressure is further boosted before being expelled to a load vessel or hose nozzle.

The Office Action first combines Richey and Muratsubaki '448, neither of which suggest a variable speed motor. To address those limitations, the Office further combines Muratsubako '372.

Like Muratsubako '448, Muratsubako '372 discusses a pump to pressurize liquid for cutting material. Muratsubako '372, however, does not include a multiple-stage pump. Instead, two pumps alternate in providing pressurized liquid to a cutting nozzle. Muratsubako '372 also does not turn on and off depending on the pressure in the first chamber and doing so would be contrary to the intended purpose of Muratsubaki '372.

Unlike the cited references, the claimed pump operates in response to the pressure in the first piston chamber "by initiating a compression stroke in the first piston in response to the detection of a predetermined pressure within the first piston chamber." (Claim 15.) Richey's pump operates at 50 rpm until the input pressure drops below a threshold level, at which point the pump stops. Neither Muratsubako reference is concerned with the input pressure. Thus, combining Richey with the Muratsubako references still does not yield a multi-stage pump that operates in response to the pressure input at the first stage.

In addition, the Applicants have amended the independent claims to recite that the first stage is connected to the second stage via a passage (30) through the housing (11) that also

includes the piston chambers, as shown in FIG. 1. This allows for a compact device more suitable for home use than suggested by the industrial pump systems of Muratsubako '448 and Muratsubako '372, each of which interconnects the piston chambers with external lines.

The dependent claims recite additional patentable subject matter. The allowability of the dependent claims follows from the allowability of the independent claims from which they depend. Because each independent claim should now be allowable, the dependent claims should also be allowable.

Reconsideration of the rejections under 35 U.S.C. § 103(a) is respectfully requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned attorney.

Respectfully submitted,

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